

CLAIMS

1. An inter-cylinder variation detection device of an internal combustion engine comprising:

5 a valve opening characteristic setting means for changing an operating angle and/or amount of lift of an intake valve, wherein the valve opening characteristic setting means can set a first valve opening characteristic and a second valve opening characteristic having a smaller operating angle or amount
10 of lift than that at the time of the first valve opening characteristic, and further

a calculating means for detecting an indicator of the state of combustion in each cylinder at the time of the first valve opening characteristic and
15 the time of the second valve opening characteristic set by said valve opening characteristic setting means and, at the same time, calculating the deviation between these indicators and a standard value for each cylinder and

a detecting means for detecting the
20 variation among cylinders by using the deviation for each cylinder at the time of the first valve opening characteristic and the deviation for each cylinder at the time of the second valve opening characteristic calculated by said calculating means.

25 2. An inter-cylinder variation detection device of an internal combustion engine comprising:

a valve opening characteristic setting means for changing an operating angle or amount of lift of an intake valve, wherein the valve opening
30 characteristic setting means can set a first valve opening characteristic and a second valve opening characteristic having a smaller operating angle or amount of lift than that at the time of the first valve opening characteristic, and further

35 a calculating means for detecting an indicator of the state of combustion in each cylinder at the time of the first valve opening characteristic and

the time of the second valve opening characteristic set by said valve opening characteristic setting means and, at the same time, calculating the deviation between these indicators and an average value of the indicators of the state of combustion for the cylinders and

a detecting means for detecting the variation among cylinders by using the deviation for each cylinder at the time of the first valve opening characteristic and the deviation for each cylinder at the time of the second valve opening characteristic calculated by said calculating means.

3. An inter-cylinder variation detection device of an internal combustion engine as set forth in claim 1 or 2, wherein

the variation of the fuel injection amount is detected by the deviation for each cylinder at the time of the first valve opening characteristic set by said valve opening characteristic setting means, and

the variation of the valve opening characteristic is detected by the deviation for each cylinder at the time of said second valve opening characteristic.

4. An inter-cylinder variation detection device of an internal combustion engine as set forth in claim 3, wherein when detecting the variation of the valve opening characteristic by the deviation for each cylinder at the time of the second valve opening characteristic set by said valve opening characteristic setting means, the amount of variation of the fuel injection amount for each cylinder detected at the time of the first valve opening characteristic is corrected.

5. An inter-cylinder variation detection device of an internal combustion engine as set forth in any one of claims 1 to 4, wherein when detecting the variation among cylinders by said detection device, control is performed so that the drive conditions at times of the first and second valve opening characteristics set by said valve

opening characteristic setting means become the same.

6. An inter-cylinder variation detection device of an internal combustion engine as set forth in claim 5, wherein said drive conditions are the rotational speed and torque.

7. An inter-cylinder variation detection device of an internal combustion engine as set forth in claim 5 or 6, wherein said detection device detects the variation among cylinders in an idling state of the internal combustion engine.

8. An inter-cylinder variation detection device of an internal combustion engine as set forth in claim 1 or 2, wherein said indicator of the state of combustion includes at least one of an air/fuel ratio, rotation fluctuation, and combustion pressure of the internal combustion engine.

9. An inter-cylinder variation detection device of an internal combustion engine as set forth in claim 1 or 2, wherein the valve opening characteristic of said intake valve is changed so that the variation among cylinders detected by said detecting means is eliminated.

10. An inter-cylinder variation detection device of an internal combustion engine comprising:

a valve opening characteristic setting means for changing a valve opening characteristic of an intake valve;

an indicator detecting means for detecting indicators of the state of combustion for each cylinder at the time of a first valve opening characteristic and at the time of a second valve opening characteristic smaller than the first valve opening characteristic set by the valve opening characteristic setting means;

a fuel injection amount variation detecting means for detecting the variation of the fuel injection amount for each of the cylinders by using said indicator of the state of combustion detected by said indicator detecting means at the time of said first valve

opening characteristic; and

a valve opening characteristic variation detecting means for detecting variation of the valve opening characteristic for each of said cylinders by using said indicator of the state of combustion detected by said indicator detecting means at the time of said second valve opening characteristic and the variation of the fuel injection amount detected by said fuel injection amount variation detecting means.

11. An inter-cylinder variation detection device of an internal combustion engine as set forth in claim 10, wherein

said valve opening characteristic setting means can change the valve opening characteristic of the intake valve for each cylinder, and

the variation of the valve opening characteristic for each of said cylinders detected by said valve opening characteristic variation detecting means is eliminated by the valve opening characteristic of said intake valve for each of said cylinders being changed by said valve opening characteristic setting means.

12. An inter-cylinder variation detection device of an internal combustion engine as set forth in claim 10 or 11, wherein said indicator of the state of combustion includes at least one of the air/fuel ratio, the rotation fluctuation, and the combustion pressure of the internal combustion engine.

13. An inter-bank variation detection device of an internal combustion engine comprising:

a valve opening characteristic setting means for changing a valve opening characteristic of an intake valve for each bank;

an indicator detecting means for detecting indicators of the state of combustion for each cylinder at the time of a first valve opening characteristic and at the time of a second valve opening characteristic

smaller than the first valve opening characteristic set by the valve opening characteristic setting means;

a fuel injection amount variation detecting means for detecting the variation of the fuel injection amount for each of said cylinders by using said indicator of the state of combustion detected by said indicator detecting means at the time of said first valve opening characteristic; and

a valve opening characteristic variation detecting means for detecting the variation of the valve opening characteristic for each of said cylinders by using said indicator of the state of combustion detected by said indicator detecting means at the time of said second valve opening characteristic and the variation of the fuel injection amount detected by said fuel injection amount variation detecting means and finding the average of the variations of the valve opening characteristics for the cylinders for each bank to thereby detect the variation of the valve opening characteristic for each bank.

14. An inter-bank variation detection device of an internal combustion engine provided with:

a valve opening characteristic setting means for changing a valve opening characteristic of an intake valve for each bank;

an indicator detecting means for detecting indicators of the state of combustion for each bank at the time of a first valve opening characteristic and at the time of a second valve opening characteristic smaller than the first valve opening characteristic set by the valve opening characteristic setting means;

a fuel injection amount variation detecting means for detecting the variation of the fuel injection amount for each bank by using said indicator of the state of combustion detected by said indicator detecting means at the time of said first valve opening characteristic; and

a valve opening characteristic variation detecting means for detecting the variation of the valve opening characteristic for each bank by using said indicator of the state of combustion detected by said
5 indicator detecting means at the time of said second valve opening characteristic and the variation of the fuel injection amount detected by said fuel injection amount variation detecting means.

15. An inter-bank variation detection device of an
10 internal combustion engine as set forth in claim 13 or 14, wherein the valve opening characteristic of said intake valve for each bank is changed by said valve opening characteristic setting means so that the variation of the valve opening characteristic of each
15 bank detected by said valve opening characteristic variation detecting means is eliminated.

16. An inter-bank variation detection device of an internal combustion engine as set forth in claim 13 or 14, wherein said indicator of the state of combustion
20 includes at least one of the air/fuel ratio, the rotation fluctuation, and the combustion pressure of the internal combustion engine.